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THE DEVELOPMENT OF INNOVATION MEASUREMENT TOOL FOR UTM UNDERGRADUATE STUDENTS

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ABSTRACT
In align with the Universiti Teknologi Malaysia tagline '*Innovative, Entrepreneurial, Global*', various efforts have been carried out by the university to encourage and enhance innovation amongst UTM undergraduate students. However, it is also essential for the UTM administration to get an indicator on the level of student's innovation as a result of various effort which had been implemented by the university, especially among the undergraduates. Hence, a research study has been undertaken to develop innovation measurement instrument for the UTM undergraduate students based on three constructs; Human Capital Innovativeness, Culture Innovativeness and Leadership Innovativeness. The methodology of this study is a quantitative approach by using questionnaire survey as data collection method. The samples were chosen using random sampling method, which involving 62 undergraduate students at Universiti Teknologi Malaysia (Johor Bahru). The data have been analyzed using the Statistical Package for Social Sciences (SPSS) version 19 and Winsteps software version 3.69.1.11. The findings indicated that Human Capital Innovativeness, Culture Innovativeness and Leadership Innovativeness are highly recommended for the instrument's constructs. Overall, the item reliability of 132 items is in acceptable range, > 0.7 and showing that these items can be categorized into 2 groups of item ability. As the result from the analysis, 2 items were rephrased and 23 items to be omitted. In total, 109 items were accepted to be included in the innovation measurement tool for assessing the UTM undergraduate students' innovation level.

Keywords: *Innovation, RASCH Measurement Model*

INTRODUCTION
Malaysia is putting its full effort through various initiatives in making the country become one of the developed and high-income countries in the world by the year 2020. To achieve this aim, one of the essential initiative is to bring up the level of innovation amongst its people comparable to the level of high-income developed countries such as Switzerland, Sweden, USA and etc. The government has introduced a number of initiatives to ensure that the target of a high-income nation by 2020 will shifts the economy through the nation creativity and innovation own products. Universiti Teknologi Malaysia (UTM) as one of the Research University (RU) in Malaysia has response to this call by initiating a number of programmes with the aims to give awareness on innovation, and to encourage the UTM community including students to involve in innovation activities whether it take place inside or outside UTM. As a huge amount of budgets were allocated and spent by UTM to encourage the development of innovation, especially to the students and there is a concern on how the initiatives or programmes have provide positive impact to the enhancement of students' innovation.

Previous studies suggest that, there are several definitions which explain innovative and generally, definition of innovative were addressed in a broad range by many researchers according to their scopes of studies. De Jong and Den Hartog (2010) described innovative work behaviors involving both the initiation and implementation of ideas. Similarly with Chang and Liu (2008) who stated that innovative behaviors refers to the intentional generation, promotion and realization of new innovative ideas. While Slåtten and Mehmetoglu (2011) emphasised that the drivers for innovative behavior in job seeking which are application of novel and useful ideas in the work role where it were considered very crucial. Therefore, an innovative workforce would lead to an innovative organisation as

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innovative behavior of an individual acts as an important pillar to support a wider scope of innovation in an organization, and the surroundings. This is why an organization which comprises by innovative skilled workers is more potentially successful in generating, and introducing new innovative ideas or products.

According to Jaussi and Dionne (2003), individuals who display themselves as a role model in innovation are expected to increase the awareness of innovation to their colleagues in the organizations. Individuals who act innovatively would potentially stimulate both innovative idea generation and behavior. Based on previous literature conducted by Kleysen and Street (2001), innovative individual generally has been conceptualized by characteristics, traits and behavior variables. However, there is still lack of study related to the individual innovative behavior especially those which could encourage to the creation of innovative outcomes or products.

One of the important aspects that could facilitate individuals or organization to encourage and enhance their innovativeness is the innovation measurement tools. Such tools will provide these individuals or organization with the indicator of the level of their innovativeness that will allow them to take the necessary actions for improvement. The question is how are we going to assess the individual innovation level and do we currently have appropriate tools to measure the level of individual innovativeness? Currently, most of the scholars used the Abbreviated Torrance Test for adults (ATTA), Kreton Adaptation-Innovation Inventory (KAI) and Torrance Tests of Creative Thinking (TTCT) as the instruments to measure creativity and creative thinking ability. Thus, what we can see is that it has a number of instruments to measure various aspects of creativity, however, the situation is quite contradict when it comes to innovation. In this context, Hurt et al. (1977) proposed that individual innovativeness should be measured based on his/her willingness to change. While, Amabile (1988) was suggesting to measure innovative behavior through product innovativeness. This implies that the innovative behavior can be construed in many measure and elements. This is in line with West (2002) who asserted that creativity can be seen as one of innovative behavior. This behavior is the most apparent in the first innovation process, where recognition of problems and performance gaps and generated ideas in response to a perceived need for innovation. However, scholars have identified and discussed in some previous studies that there is difference between innovative behavior and creativity. The innovative behavior proposed to produce benefits since it is expected to result in innovative output.

In this study, the researchers focusing on three elements to be included as the main constructs in the measurement instrument which are Human Capital, Culture, and Leadership. The Human Capital element consists of Knowledge, Skills, and Towering Personality which parts of elements that emphasized in the 10th and 11th Malaysia Plan. The element of Culture is suggested based on the Innovation Model by Dobni (2008) which consists of Innovation Propensity, Organizational Constituency, Organizational Learning, Creativity and Empowering, Market Orientation, Value Orientation, and Implementation Context. While the element of Leadership adapted from Big Five Factors (King et al., 1996; Feist, 1999) which consists of Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism.

This article is reporting a study which undertaken for developing a measurement tool for assessing students' innovation level. The aims of this study are to test the reliability, and examine the consistency of the measurement tools when being used in assessing the innovation level of undergraduate students in UTM.

METHODOLOGY

The survey was administered randomly to 62 students who are studying at Universiti Teknologi Malaysia, Johor Bahru Campus (UTM JB). There are 28 engineering students and 34 non-engineering students. The instrument testing was involved the analysis of 132 items from 3 constructs and 15 sub-constructs or dimensions. Content and face validity is essential to make sure the concept and meaning of the questionnaire do not contradict, easy to understand and valid (Gay et al., 2006). Instruments in

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this study consist of 2 parts namely; i) Part A contains items related to the background of respondents such as gender, race, age, CGPA, year of study and programme and ii) Part B consist of items measure the innovation constructs. The students were expected to response all the items given based on their perception, and the level of their innovation will be determined using Rasch Measurement Model analysis. The Rasch Measurement Model (RMM) is one of IRT-based measurement (sometimes called latent trait measurement) and has been reported by researchers (Abd-El-Fattah et al., 2014) as RMM have an increase in the importance of good measurement.

Basically, there are three concepts of Rasch analysis; the estimates of item difficulty; person ability and the relationship between item difficulty and person ability. According to RMM estimates the item difficulty from the responses of a set of respondents, by taking into account the ability of the candidates and the degree of match between the ability of the group and the difficulty of the items. In Rasch analysis, items and person parameters are estimated according to the probability of their response patterns given the person ability and item difficulty. Further, Rasch also estimates a person ability are equivalent to scoring in a test.

RESULTS AND ANALYSIS

Validity of instrument is a very basic requirement to achieve a good measure. The findings from the study found that the value for person reliability is 0.98 with separation index of 6.91. This demonstrates that the instrument has wider ability range and there are about 7 levels of person ability to be categorized.

The value of item reliability for the instrument is 0.78 with the item separation index of 1.88. Thus, Items reliability greater than 0.7 indicates items in this instrument is highly acceptable (Bond & Fox, 2015). Reliability of 3 main constructs show good person reliability from 0.94 to 0.96. In addition, the respondens separation index for all constructs is acceptable, ranging from 3.92 to 4.31.

Unidimensionality is one of the fundamental requirement for RMM to obtain the items in the instrument measure only a single construct. Raw variance explained by measures is the benchmark of the instrument unidimensionality. Based on the analysis, the raw variance explained by measures is 34.5% and closely match the model 34.9% and should be greater than 20% (Reckase, 1979). The value of unexplained by variance in 1st contrast is 5.4% and found to be well controlled because does not exceed 15% (Azrilah et al., 2013).

Polarity item analysis determines whether all items are moving in one direction with the constructs. Results shows 132 items consists of 15 sub-constructs indicate the PTMEA correlation value is positive.

The value of infit MNSQ and outfit MNSQ of each item and person show the suitability of items in measuring the constructs. Wright (1994) stated that the infit MNSQ and outfit MNSQ of rating scale instrument should be in range between 0.6 to 1.4.

Table 1 shows that person 43 appears in every construct as the misfit person. Besides, other respondents with ID 11, 37 and 49 also considered as misfit since their value of MNSQ more than 1.4. Items TP06, OC06 and CS01 might be confused. Other misfit items that have value below than 0.6 logit represent by each construct are items VO02 and EV04. Wright (1994) stated that the infit MNSQ and outfit MNSQ of rating scale instrument should be in range between 0.6 to 1.4. Thus, more attentions need to be put into these five items and four respondents.

Table 1. Item and person fit for each construct in instrument

Constructs	**Item Infit MNSQ**				**Person Infit MNSQ**			
	Min	Item	Max	Item	Min	ID	Max	ID
Human Capital	-	-	1.77	TP06	.06	43	2.99	11

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Culture	.45	VO02	1.72	OC06	.05	43	2.37	49
Leadership	.44	EV04	2.57	CS01	.15	43	2.32	37

DISCUSSION AND CONCLUSION

Based on the data analysis, it showed that the reliability of all the 62 students, and the 132 items (3 main constructs with 15 sub-constructs) is very high in measuring students innovation level. According to Rasch Measurement Model, person reliability more than 0.8 is consider very high (Bond & Fox, 2015; Linacre, 2005). Besides, items reliability greater than 0.7 indicates items in this instrument is highly acceptable (Bond & Fox, 2015). This implies that items can be categorized into 2 groups of item ability. It means that the items are enough to separate items. Positive PTMEA CORR value shows the item measure the constructs to be measured (Bond & Fox, 2015). Thus, the items contribute to the measurement of innovation level. Positive and high value of CORR PTMEA shows the items are able to distinguish between respondents' ability.

Wright (1994) stated that the infit MNSQ and outfit MNSQ of rating scale instrument should be in range between 0.6 to 1.4. Items with value more than 1.4 logit are considered as ambiguous item, but not degrading. If the items below 0.6 logit, this indicate that the items are too predictable. Hence, the items must be dropped or repaired if the items do not meet the conditions stated. Based on the analysis, there is no item from Human Capital construct with minimum value of MNSQ. Thus, more attentions need to be put into these five items (TP06, OC06 and CS01, VO02 and EV04) and four respondents (ID43, ID11, ID37 and ID49). Therefore, from the analysis, the Rasch Measurement Model will recommend these items whether to be deleted, rephrased and improved. Preferably, purification and removal of the items done by reviewing the literature, objectives and purpose of measurement. From the analysis it was found that 3 items were rephrased and 23 items were retained. As a result, 109 out of 132 items were accepted to be included in the instrument. Therefore, the yielded items are tested and have been verified by Rasch Measurement Model in ensuring the items and instrument itself to be used in the actual study have better quality. Table 2 shows the summary of the analysis for the items based on the constructs and sub-constructs

Table 2. Summary of the items analysis based the constructs and sub-constructs

Construct	Sub Construct	Total	Omitted	Rephrased	Added	Total
Human Capital	Knowledge	11	4	0	0	7
	Skills	14	3	0	0	11
	Towering Personality	8	1	0	0	7
Culture	Innovation Propensity	6	0	1	0	6
	Organizational Constituency	6	1	0	0	5
	Organizational Learning	7	1	0	0	6
	Creativity and Empowerment	12	0	1	0	12
	Market Orientation	7	0	1	0	7
	Value Orientation	5	1	0	0	4
	Implementation Context	8	1	0	0	7
Leadership	Openness	10	0	0	0	10
	Conscientiousness	10	6	0	0	4
	Extraversion	9	2	0	0	7
	Agreeableness	7	2	0	0	5

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	Neuroticism	12	1	0	0	11
Total		132	23	2	0	109

As a conclusion, all the constructs tested are highly recommended although there are some items that need improvement and being discarded. The items of the constructs and sub-constructs are proven reliable, and consistent according to the Rasch Measurement Analysis. Hence, the research aims of this study to develop a measurement tool in measuring UTM undergraduate students' level of innovation is achieved.

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